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ABSTRACT

Eight programs are described that are representative of the variety of approaches to the problem of integrating the sciences and humanities. The reason why integration of science, humanities, and the social sciences is important in the undergraduate learning experience is addressed in an essay by George W. Hazzard entitled, "Knowledge Integration in Undergraduate Liberal Learning." The following eight program descriptions are presented: interdisciplinary holistic teaching/learning program at the Claremont Colleges; science of man program at Marist College; environmental studies program at New College; humanities perspectives on technology program at Lehigh University; liberal arts humanities program at Quinnipiac College; interdisciplinary studies program in letters and sciences at Saddleback Community College; interdisciplinary core curriculum program at Lakeland College; and the NEXA program at San Francisco State University. Additional programs at other institutions and resource materials on the topic are listed. (SW)

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The Forum for Liberal Education

Forum

Association of American Colleges 1818 R Street, N.W., Washington, D.C. 20009

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May, 1979

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The *Forum for Liberal Education* is a topic-oriented publication featuring a subject of importance for liberal education in each issue. It does not endorse or evaluate institutional activity. Rather, it describes the various ways in which institutions of higher education address important common concerns.

Integrating Sciences and Humanities

In the years since C.P. Snow wrote about the two cultures, many individuals have been concerned about the gap between the sciences and the humanities in higher education. On many college campuses the situation has worsened with the lifting of distribution and general education requirements that obligated students to experience the major areas of knowledge.

Many colleges and universities are attempting to break through the overspecialization and isolation of departments to bring about a more integrated study of broad human questions. Some institutions emphasize the faculty: the Claremont Colleges, for example, encourage faculty members to learn about other disciplines from their colleagues. Other programs stress the value questions which underlie scientific developments. In some cases, the linkages come from a prescribed series of courses that culminate in an integrative experience. Still others take a specific theme, such as the environment or the development of technology. The eight programs featured here only suggest the variety of approaches that have been made to the difficult problem of integrating the sciences and humanities.

Knowledge Integration in Undergraduate Liberal Learning

by George W. Hazzard
Director, Project QUILL
President Emeritus, Worcester Polytechnic Institute

In this era of new human problems it is comforting to know that some problems are permanent with no permanent solutions. It is equally comforting to observe the human confidence and stubbornness that prevents the giving up of attempts at finding such solutions. Thus the present issue of *Forum* is an epitome of the unquenchable human spirit as shown by the search for better, more effective, more satisfying ways to integrate science, humanities, and the social sciences in the undergraduate liberal learning experience.

Why is this integration so important to so many participants in college education in such varied institutional settings? Perhaps the simplest answer is to say that those who teach wish to share the joy of learning in its various manifestations, to show every student the pleasure that can come from different ways of knowing. That is why we argue so much about distribution requirements and what crucial elements of one intellectual discipline should be understood by those in another. Thus science, with its ever expanding universe of knowledge and its ever new ways of thinking about the unknowns of the natural world should be a fascinating component of liberal learning.

A second answer, frequently given, is more sociological. Our present world is what it is, with all its positive and negative aspects, in large measure as a result of science. Continuing human persistence in applying the know-

ledge and insights of science to the every day problems of living has fundamentally changed how we live and how we think about our living. If we fail to understand how science and its practical offspring, technology, affects us or can be affected by us, we cannot claim to be liberally educated.

A third answer could be construed as religious in context. The liberated mind is one which can think logically about any problem affecting human experience. Such a mind will not blindly accept any imposed authority. It must not take the statements of science as "true" without subjecting them to the same careful and understanding scrutiny it would give to the statements of politicians, philosophers, or priests. But such scrutiny cannot occur if one is ignorant about science. Integrated liberal learning can make such scrutiny informed and intelligent and avoid having the practitioners of any discipline, science especially, from becoming the high priests of the modern world.

As usually happens, an objective as important as integrated liberal learning is not easily accomplished. Almost every college catalog expresses recognition of the need for integrating science into the common learning experience of undergraduates, yet the implementation of such integration fails more often than it succeeds. The reasons for that failure lie partly in human nature and partly in human knowledge. The enormous growth of human knowledge has resulted in increasing specialization and fragmentation. With that comes the lack of time and motivation to be a generalist. Human nature takes over and has a faculty member guiding students well in his own profession but finding it ever more difficult to advise them about critical elements of knowledge in others. With a role model of a faculty member living in happy ignorance of other disciplines, why should not a student do likewise?

Fortunately college faculty members are teaching not alone for the pleasures of their own discipline but because they do have a larger vision of what liberal learning is all about. They do join in periodic collegial examination of their goals, of their implementation of those goals, and of the effectiveness of their efforts. And they rise over and over from the ashes of the previous "final solution" to implement a new one. Thank goodness for human optimism.

Given the desire for integration of science with the humanities and social sciences, how does one get to solutions like the ones presented here? There is no perfect way but there is one basic requirement. All disciplinary representatives must really want integration to happen. They must be willing to give up time. They must give up time in the curriculum for integrative purposes even if that means omission of some supposedly essential course, seminar, or project in their own discipline. If that "sacrifice" can be made, then the first major bar to integration has been cleared.

It is worth remembering that similar choices are made every year in each discipline. As each department seeks to strengthen the quality of its offerings it inevitably is forced to abandon simple addition and go to selection. Somehow faculty need to find the courage and the commitment to extend this selectivity; to put broad knowledge integration ahead of the narrower requirements of the discipline. We all recognize that the *process* of acquiring and manipulating knowledge is a critical part of liberal learning. But we find it as difficult to omit content as to give up food and drink to achieve desired physical fitness. To me, the process of deciding what can be left out and still give the essential paradigms of the discipline is liberal learning for the faculty member.

Given the faculty desire for integration, who should do it? At first glance one sees the young faculty member as the moving force and the older faculty member as the inertia to be overcome. Perhaps it is so that the younger faculty have the ideas but not much of lasting effect will happen until the secure, tenured faculty member accepts these ideas and pushes them. My experience suggests that a phrase coined by a faculty colleague is the apt one.

"What created change here," he said, "was the presence of a bunch of tenured, middle-aged Turks."

Any faculty that can find enough middle-aged Turks to create an integrative scheme and convince two-thirds of that faculty to join them in it has the necessary elements for successful change.

To the integration we are considering there is another road block, one not necessarily toppled by the programs presented by *Forum*. This is a road block that might be described as using a sub-critical mass to start the desired reaction. In more homely terms, it is like trying to start a fire with wet wood and not enough kindling. We try to solve integration with a single course, or at most two, as part of the distribution requirements. Yet when one tackles the job of creating true understanding of as big a part of human knowledge as science represents, such a small effort is not enough. At least some of the programs herein described do seem to address that problem successfully.

As one looks at the interesting and creative programs described in *Forum* one sees good efforts to overcome another road block to interdisciplinary understanding. This one is a language road block, the language of quantitative thinking, the language of mathematics. In a way most humanists or social scientists must "read science in translation" without knowing its native language, mathematics. The scientist, however, is fortunate in being able to read the humanities and social sciences "in the original" since he already must know English.

Thus it is that many of the projects here deal with the biological (environmental) sciences where powerful scientific ideas can be conveyed with words. Important as it is to convey these ideas, it is equally important and much more difficult to convey the powerful effects of mathematical and statistical quantitative relationships. Even the simpler process of demonstrating the value of the laboratory as a probe to understanding complex phenomena is less used in these programs than in earlier times.

Perhaps that is why one suspects that places like Lehigh and Quinnipiac find it easier to "humanize" their science or engineering students than do Saddleback or South Florida do to "scientize" their humanists. Perhaps the Claremont Colleges have a good compromise as their faculties try to teach colleagues about other disciplines than their own. Yet in almost all of these programs one senses the strong underlying urge to show all students that there is a values system underlying the work of every humanist, social scientist, or natural scientist. Perhaps in the interdisciplinary give and take of creation of these courses self discovery of that fact will lead to better teaching in a person's own discipline.

Let me conclude by returning to the fact that science is

too important to the modern world not to be included in the education of all undergraduate students. Equally an understanding of the strong insights, values, and organizing principles of the humanities and social sciences is essential for a scientist who would retain his humanity. Undergraduate education should bring us closer together in understanding the real world of people and things.

The Claremont Colleges
Interdisciplinary Holistic Teaching/Learning

The Claremont Colleges have implemented a collaborative faculty development effort to integrate a broader range of the sciences and humanities into existing courses. The program, entitled Interdisciplinary Holistic Teaching/Learning, was founded on the premise that faculty members, as well as students, suffer from a traditionally narrow disciplinary organization of education. In this collaboration, faculty teach one another by class attendance, seminars, and informal contact, the knowledge needed for this integrative approach.

The mainstay of the program is a series of regularly-scheduled seminars providing faculty (and interested students) with a broad and more comprehensive awareness of interdisciplinarity. In the two years of the program, seminars have included such on-going topics as Sociobiology, Artificial Intelligence, Seventeenth Century Science and Literature, and Values and Education. Additional seminars held during the school year and over the summer supply methods of integrating interdisciplinary themes into traditional courses, producing bibliographies, case studies, and other materials which aid the instructor to become a more effective teacher as well as learner, and which subsequently encourage the restructuring of traditional, narrow educational thought. In January 1977, the project sponsored a conference on Learning Styles and Cognitive Development. Attended by 50 faculty and administrators, it discussed the variety of learning styles and the ways in which colleges can deal with this diversity. Another conference, entitled How We Learn, How We Teach, was held in January 1978 and emphasized such teaching techniques as encouraging participation and interaction in the classroom, fostering better use of assigned texts, and improving lecture and discussion styles. Ninety faculty members from the Claremont Colleges and other California institutions attended this conference, which has become a model for participants to use on their own campuses

Both the seminars and the conferences have enabled faculty to bring new insights into their respective disciplines. Ideally, this newly-gained knowledge will facilitate a transformation of individual instructors and subsequently allow a synthesis among the sciences and humanities in the courses that they presently teach. One example of this interdisciplinary approach is a sophomore calculus class which synthesizes the facts and techniques of mathematics with humanistic concepts of values and esthetics. The course begins with a reading and discussion of Jacob Bronowski's *Science and Human Values* in order to develop a sense of exploration and discovery in mathematics. Seven calculus textbooks are assigned, of which at least two are consulted for each topic on the syllabus. Homework problems are drawn similarly from two texts, so that students will notice differences in the approach and notation of various authors. In this way, a deeper synthesizing and understanding of the material takes place. Another innovation in this course is the cooperative examination, in which the class collectively arrives at the solutions to the exam questions. While this has become an effective participatory learning experience, the final exam remains an individual effort. The course also includes Jacques Hadamard's *The Psychology of Invention in the Mathematical Field*, and discussions on such topics as the responsibility of scientists, fractional integration, and computer-generated poetry.

As faculty have become more concerned with processes of teaching and learning, some unexpected side benefits have resulted. For example, the insights gained while preparing a special faculty collaborative seminar on Structuralism in Natural and Social Sciences led to a semester-long series of lunch time discussions about expository writing. It was concluded that teaching and learning writing cannot be approached as a mechanistic or sequential exercise. The project sent several representatives to a special conference in San Francisco on writing, and as a result, a faculty committee is preparing a proposal for an all-Claremont writing program.

Another outcome of the project has been the introduction of jointly taught interdisciplinary courses (bringing together physics and humanities, for example), and the attendance by faculty of some of their colleagues' classes. In this way, interaction between faculty and their comprehension of other disciplines has been increased.

One of the goals of the project has been the convincing of faculty, administrators, and students of the worth and feasibility of honest integration. One measure of its success is in its increased visibility and popularity among faculty of the six campuses. But while most faculty do not presently intend to transform themselves or their courses in an interdisciplinary direction, those who are moving in that direction are no longer considered radical. The project hopes to create an ambiance that encourages innovation, experimentation, and attention to its integrative themes.

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Marist College
Science of Man Program

The Science of Man Program at Marist College pays special attention to the interrelation between the logic of the humanities and the logic of the sciences and the values base upon which these two rest. The program spans three years and acts as an integrative center for the liberal arts studies of students enrolled; as such, it replaces most of the core courses required of other students at Marist.

The program is structured in four parts. Stage one is a two-semester freshman course that examines metaphysical and epistemological questions within the natural and social sciences. The course seeks to combat the overspecialized and competitive nature of modern academic life by specific training in the tools of several scholarly disciplines and by cooperative small group inquiry. Students also choose topics of personal interest for interdisciplinary research to lay the groundwork for the research that culminates in stage four.

Stage two is a one-semester course in the roots of western civilization. The aim is to alert students to the many factors that influence history, as distinct from a purely political, economic, or social history approach. In stage three, students explore the nature of scientific method through the study of physics. Since students have varying scientific backgrounds, the course is taught at different levels, but all take a philosophical and historic as well as a scientific approach. The attempt is made to understand some of the great breakthroughs of twentieth century physics.

The fourth stage is a thesis, the result of three years of interdisciplinary study of a special project. The process of doing the thesis allows students to view a topic of personal interest from as many disciplines as possible, as well as to engage in a process of self-discovery. In addition, each student has the opportunity to write in scholarly fashion what he or she has thought about in depth during the three year period.

Over its seven years of existence the Science of Man program has maintained an enrollment of about 100 of Marist's students. It is particularly attractive to highly motivated, academically able students who want to complete a B.A. in three years. In addition to the four-stage program, students must complete 96 credit hours, including a writing requirement, one course each in history and fine arts, and major field requirements. Many graduates of the program have found that this rigorous and integrated program has provided a strong foundation for graduate studies as well as for their personal lives.

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New College
Environmental Studies Program

New College, a part of the University of South Florida, is a separate, honors program in the liberal arts and sciences. It uses an educational contract system allowing students to design their own programs of study, and requires a three-year, full-time commitment from them for the B.A. degree.

The Environmental Studies Program (ESP) was instituted in 1974 to do basic research and to function as a community service. To capitalize upon the educational opportunities provided by this research program, a faculty committee was formed, drawing upon the research faculty in ESP and from the divisions of the natural sciences, social sciences, and humanities. In turn, this committee has directed the development of interdisciplinary humanities courses concerned with human values, courses broad in scope intended to insure that students will supplement their research-oriented work with humanistic considerations. New College has offered 48 courses of environmental study since 1974, of which 36 were unique titles. One-half of the courses were sponsored by the ESP; one-fourth were given by the natural sciences, six by the social sciences, and three by humanities. Four interdivisional courses were given.

In order to strengthen the humanities component of the program, a grant from the National Endowment for the Humanities produced a two-course sequence on humanistic approaches to environmental issues. Designed to provide a humanistic framework for addressing evaluative questions concerning mankind and the environment, the sequence brings this framework to bear upon concrete environmental problems. Discussions involve different models of the relationship of human beings to the environment as well as models of relationships among peoples, since attempts to improve the environment must necessarily appeal to the rights and duties of individuals. The two courses of the sequence, Humanities and Environmental Issues, and Planning and Property, view these models from four perspectives: environmental aesthetics, which explores philosophy, religion, literature, and the arts for an ideal concept of the universe; environmental ethics, with emphasis on individual rights as opposed to cooperation with the environment; professional ethics for environmentalists, making a distinction between enlightened advocacy of a position and propagandizing; and practical applications of the humanistic framework, in which a central, practical environmental problem is chosen as a test case for the results of these theoretical examinations. Specifically, the Humanities and Environmental Issues course provides the cultural and ethical concerns of the sequence, while Planning and Property looks at property rights, growth issues, and the search for creative solutions to environmental problems.

A recent report based on enrollment figures indicates that one-third to one-half of the student body participated to some degree in the educational offerings of the ESP. Approximately ten to fifteen New College students graduate each year with ESP majors.

The Environmental Studies Program is in the process of a long-term revision which will clarify the relation of the structural elements of the program (research, instruction, community service) and increase student-faculty

interaction. Beginning in the fall of 1979, ESP students will be required to take a core course in each of the three major areas: Humanities and the Environment (Humanities), Environmental Psychology (social sciences), and Environmental Biology (natural sciences). With environmental problems continuing to be an important national concern, ESP looks ahead to an ever-increasing role in focusing this concern on to reasonable, workable solutions.

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Lehigh University
Humanities Perspectives on Technology

The Humanities Perspectives on Technology (HPT) program is an interdisciplinary effort to explore the relations between science, technology, and society: between ideas, machines, and values. The program promotes the development of courses analyzing the social and personal implications of science and technology and studies the natures of both from the perspectives of those persons engaged in these activities. HPT is the focus for a wide range of courses, a minor in Technology and Human Values, and related non-curricular activities.

With funding from the National Endowment for the Humanities, the HPT program has developed over 35 courses in a variety of subject areas. While some of these courses have been offered only on a one-time experimental basis, 22 of these courses have been added to the catalog. These offerings range from Biology and Society (biology), Technology Assessment (government), and Politics of Science (journalism) to The Ancient City (classics), Myth of Knowledge (English), and Science, Theology, and Technology (religion studies). Two basic HPT courses have been developed: Technology and Human Values, which looks at the impact of technology on society in relation to ethical problems raised by the exploitation of technological innovations; and Science and Human Values, which examines classical, modern, and contemporary scientific interpretations of nature for the interpretations of mankind embedded in them. Additional course development has continued despite the end of the grant period, and such courses as Human Values in Antiquity and Literary Approaches to Science have been offered. An Andrew W. Mellon Faculty Development grant supporting two more courses, Impact of Technology on the Fine Arts, and The Machine in America, is indicative of general interest and support at Lehigh for continuing HPT-oriented activity. The problem of increased faculty workload caused by these additional courses has been alleviated by offering them on an alternating basis with existing, low-enrollment courses; in this way, no courses have been dropped due to the HPT program. Approximately 70 faculty members have been involved in HPT activities.

The HPT program offers an interdisciplinary minor in Technology and Human Values, for which students take a set of courses drawn together by a common HPT focus and consisting of at least eighteen credit hours. One of the two basic HPT courses is required, as is a course in the history of technology; the elective courses are drawn from a list of 42 related offerings. The HPT minor is acceptable for students in each of the three colleges of the university: Arts and Science, Engineering and Physical Sciences, and Business and Economics.

A significant part of the HPT program has been a dissemination effort designed to help other schools profit from Lehigh's (and others') experiences. With the aid of a follow-up grant from the NEH, the "sharing" phase of the program has involved workshops, bibliographies, and a newsletter. A curriculum development workshop conducted in the fall of 1977 attracted 56 participants from a variety of two- and four-year institutions. Several annotated bibliographies have been developed under the program, including a book-length version, *Technology and Human Values in American Civilization*, which will be available in spring 1979. The curriculum newsletter of the HPT program, with a present mailing list of over 2,000 persons, is the most extensive of the dissemination activities. Designed to help generate new courses and to serve as an information exchange, the newsletter includes articles on course development, overcoming problems in instituting new courses, reviews of teaching aids, and additions to previously published bibliographies. In addition, the newsletter has recently begun a syllabus exchange for courses in the history of technology.

Other non-curricular activities begun during the grant period are continuing, although on a reduced level. A movies and guest lecture series is open to all students and provides a balance to classroom activity, while an informal faculty supper and lecture program encourages cohesiveness among its interdisciplinary participants.

The HPT program was established on the belief that the study of the impact of technology on the quality of life is crucial, and that the overall engineering climate at Lehigh made it an appropriate site for such study. The program has had to overcome initial reluctance to the concept of humanities and technology integration, and has slowly built bases for interaction with the business and engineering colleges. Having met these difficulties, the program has continued to receive the support of the university administration, notably in the combination of the Andrew W. Mellon Professorship in the Humanities with the directorship of the program; from the colleges, by their acceptance of the HPT minor for their students; from the faculty, in their enthusiasm to create or revise courses for the program; and from the students, of whom 1200-1500 annually enroll in HPT courses. As it continues to mature and expand, HPT will focus on a greater exposure of the sciences and engineering disciplines to its liberal arts students.

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Quinnipiac College

Liberal Arts Humanities Program

Faced with a steadily decreasing enrollment in humanities courses by students in its School of Business and School of Allied Health and Natural Sciences, Quinnipiac College is in the midst of a one-year trial period for a proposed, four-year basic humanistic education program. With the support of a pilot grant from the National Endowment for the Humanities, two freshman level courses have been developed and are now being tested in the classroom.

The two pilot courses are interdisciplinary combinations of formal lectures and discussion groups. They attempt to persuade students to regard the humanities as essential learning, and assist in the development of critical, analytical, and communication skills. Life Processes explores the meaning and reflections of humans in differing societies as they pass from one stage of life (birth, puberty, marriage, death) to another. It examines these stages as reflected in literature, ritual, and art, and ultimately makes apparent those realities which lie at the root of all human experience, whatever the cultural variation. The second course, Modern Institutions and Ideas, looks at the origin and development of several major institutions and ideas that have emerged in the modern world. It demonstrates both the continuity and change in concepts of mankind, theories of government and social structure, technology, and the principles of freedom and liberty which helped form western tradition.

During this semester, freshmen in the School of Business and the School of Allied Health and Natural Sciences, and 25 percent of all freshmen in the School of Liberal Arts, will be expected to substitute one of the pilot courses for one that they would otherwise take in the humanities.

If these courses are well-received by both students and faculty and the entire program is implemented, Quinnipiac hopes that they will encourage a greater appreciation for the humanities among non-liberal arts students. Moreover, the program will replace the humanities requirements for students in business and allied health concentrations.

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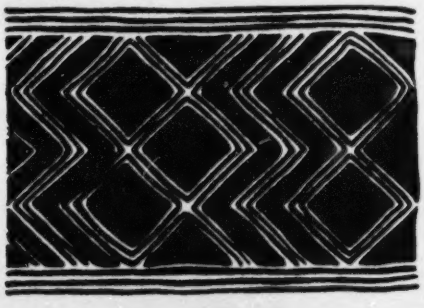

Saddleback Community College

Interdisciplinary Studies Program in Letters and Sciences

Saddleback Community College, founded in Orange County, California, in 1967, has a present enrollment of over 14,000 students. The Interdisciplinary Studies (IDS) program established in 1976, combines different approaches to interdisciplinary studies and team-teaching with the belief that a fundamental relationship exists between letters and sciences. As a result of the program, five interdisciplinary courses have been developed and added to the curriculum.

The IDS program was founded with two underlying assumptions: there is no single, interdisciplinary point of view, and each discipline has an equally valuable but distinctly different contribution to make to knowledge. In planning IDS, part of the challenge was to provide a common cultural experience in the humanities and sciences for a student population of widely diverse background and still maintain high academic standards. Faculty have had a key role in the development of the program, primarily through released-time arrangements and an intensive summer faculty retreat for the planning of these new courses. It was recognized early on in this process that not all faculty members are comfortable with team-teaching situations, and that the ability to work in a team is essential to the success of the program. In addition, the interdisciplinary nature of the IDS program necessitated that it would recruit faculty with more than one area of expertise. The result has been a core of enthusiastic faculty who evenly divide their time between IDS courses and their home discipline; new faculty are now being phased in while more experienced faculty are reducing their IDS commitment to one-quarter time.

The IDS program's initial offerings were two core courses designed around themes having broad appeal in order to expose students to process and content from a variety of disciplines. In one example, Exploring Connections: Time, Space, and Deities, the subtopic of relativity is treated by a philosopher (ethical relativity and existentialism), a scientist (Einstein's theories of Special and General Relativity), and a literature teacher (moral relativity in Camus' *The Stranger*). The other core course, Individualism: The Search for Meaning, focuses on the theme of individualism in art, literature, film, the sciences, and social sciences, and explores relationships of the individual to other persons, institutions, and the physical and cultural environment. Core courses are taught by teams of four faculty members each; classes meet for three-hour lectures and an additional weekly seminar hour. Class size averages from 25-95 students in the large class sections and 6-20 in the seminars.

Three additional courses have been developed, one taught by a team of three and two by teams of two each. The Sea: Structure and Symbol examines the physical structure of the sea from a scientist's point of view and compares this reality with the symbol of the sea as mythologized by writers. The City uses anthropology, sociology, psychology, history, and political science to look at the role of the city in human development. Planet Earth

in Contemporary Time, which will replace Exploring Connections as a core course, examines global issues (for example, world population, hunger, and terrorism) which confront humanity both now and in the foreseeable future, from social, educational, biological, economic, and political perspectives.

Every IDS course carries credit towards fulfilling Saddleback's general education requirements. After some consideration, faculty determined that the IDS program would not follow through an earlier proposal to develop a major, since it would largely duplicate present general education offerings. As an alternative, the program is developing a suggested, logical sequence of IDS and related courses to put the subject material into a better perspective.

Public activities related to IDS have given the program a greater visibility on campus. A film series for IDS students was opened to the community at large. A lecture series, drawing upon speakers from both within and outside the Saddleback community, was integrated into regular class presentations; many non-IDS faculty brought their own class sections to attend these lectures. A Distinguished Lecture Series is planned to bring speakers of national reputation to the campus in the future.

Another feature of the program is the creation of a writing adjunct, a special English class earmarked for IDS students. Taught on a one-to-one basis, the adjunct permits its students to work on IDS writing assignments while fulfilling requirements for the English course. The writing adjunct has been successful in reaching the student who has some writing skills and who needs extra attention and encouragement. For the student whose writing skills are inadequate to college level performance and who do not take the adjunct, the faculty has assembled a package of materials entitled *Putting It Together*, which includes sections on writing essays, research papers, and articles on techniques for dealing with stress in the classroom. This booklet is now given out to all students when they first enroll in an IDS course.

During its three years of operation, the IDS program has generated new communication and enthusiasm among Saddleback's faculty and students. Faculty are drawn to the program because of the challenge of something new and difficult, the broadened spectrum of teaching techniques, and the rapport and shared enthusiasm among colleagues across disciplinary lines. Students are being introduced to subjects which they shunned before exposure in an IDS class; at the same time, special activities (museum and theatre trips, picnics) for program faculty and students have helped to establish a stronger sense of participation in a learning community. Encouraged by the success of the IDS format, the interdisciplinary approach is serving as a model for other new programs at the college.

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Lakeland College

Interdisciplinary Core Curriculum

Lakeland College, a private liberal arts college with an enrollment of approximately 550 students, recently developed three interdisciplinary core courses as part of its general curriculum revision. This core, supported by a pilot grant from the National Endowment for the Humanities, provides opportunities for students to test and compare a humanities perspective against perspectives of other disciplines. The senior level core course, entitled The Haven Nuclear Generating Plant: A Case Study in Facts and Values, groups students into multi-disciplinary teams to deal with complex contemporary problems, and demonstrates the importance of a humanistic perspective in areas where resolution demands a high degree of technical expertise.

The course examines the technological, economic, ethical, and sociological questions raised by energy production and use, including a specific analysis of the proposed atomic generating plant at Haven, Wisconsin, six miles from the Lakeland campus. This topic was chosen because of a high degree of local interest as well as the necessity of a reasoned approach to the facts and opinions of the case. Additionally, the issue of power generation and consumption lends itself to a multidisciplinary research approach in which facts, opinions, and proposed solutions demonstrate the practicality of the humanistic concern with what ought to be done.

The first three weeks of the course are devoted to background readings on energy production and use. The following nine weeks focus specifically on the Haven plant, giving attention to such questions as the reasons for "going nuclear," the alternative technologies and economies of nuclear and conventional power generation, the problems of risk and responsibility, and public reaction. To facilitate the research process the class is divided into multidisciplinary teams investigating one of three topics: the ethics of energy, examining the ethical implications of energy generation and consumption and the questions of plant operation and safety, waste disposal, and environmental responsibility; the economic impact of energy, specifically the potential economic impact of the plant on the surrounding community, a cost-benefit comparison of nuclear and alternative fuels, and projections for future energy usage; and community attitudes, studying the planning efforts and the interaction between public and private agencies in deciding on the Haven plant proposal. During this nine-week period each team makes regular reports on its progress to the rest of the class; at the end of the course a written summary of the group's findings and recommendations is presented. Each of the three instructors for the course works closely with these teams; however, by being part of a team that is not in his own area of expertise, the faculty member does not assume a leadership role, and allows the student experts to lead the team.

In its initial offering this past spring, fifteen students enrolled in the course. Additional campus-wide interest grew as a result of the Three Mile Island incident, when class members suddenly became local experts on that situation. Because of the variety of questions still unan-

swered about nuclear power generation, the Haven course is likely to continue to be an effective and relevant approach to combining scientific and humanistic perspectives.

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NEXA

NEXA, the science-humanities convergence program at San Francisco State University, was established out of the concern of certain faculty members that the rigid compartmentalization of traditional education often fails to consider the close relationship between societal ethics and politics and current scientific theory. Funded by the National Endowment for the Humanities, NEXA is a five-year teaching and research program which provides courses focusing on issues of concern in both the humanities and the sciences and consequently serves to dissipate barriers between these areas of scholarship. A student can major or minor in the NEXA curriculum with all courses counting toward General Studies or elective credit. In addition, NEXA offers public events, involving both professionals and community members, on current topics in the sciences and humanities.

The first year of the program (1975-76) was exclusively a planning period, resulting in ten interdisciplinary courses being offered the following year. Since that time, the number of courses has varied from sixteen to eighteen. Each course is team taught by a scientist and a humanist and is offered once a year, with the exception of a writing course taught every semester by a single instructor. By devoting equal attention to the sciences and the humanities in each course, the barriers between different modes of inquiry become obscured and the relationship between these two areas of thought emerges.

Courses are grouped under three headings: Concepts, Sequences, and Issues. Students are encouraged to begin their NEXA program with one of the Concepts offerings, currently Cosmologies and Worldviews, Mythic and Scientific Thought, and Time in Human Consciousness. These courses explore such topics as differing concepts of the universe, of self, and of society; alternate modes of explaining natural phenomena; and the absolute or relative nature of time.

The emphasis on history as an underlying structure is most obvious in the Sequences courses. This series examines the philosophy, art, literature, religion, and physical and natural sciences of significant periods of change in western history. Entitled The Freudian Revolution, The Copernican Revolution, The Newtonian Revolution, The Darwinian Revolution, and The Einsteinian Revolution, these courses continue the theme of science-humanities convergencies. Students examine the context in which these important scientists worked as well as the implications of their ideas for the ways in which people subsequently viewed their world.

Issues courses address important current topics that cross disciplinary lines. Some current issues courses are Split Brain/Split Culture?, and examination of such dualisms as animal/human, intuition/reason, art/science, East/West?; Literature, Arts, and Physics, an evaluation of twentieth century changes in artistic and scientific ways of seeing and repressing reality; and John Steinbeck and "Doc" Ricketts: Literature and the Sea, a discussion of marine biology and the relationship of environmentalist Edward F. Ricketts to the works of John Steinbeck.

A student who elects to minor in the NEXA program must take seven NEXA courses, including at least one in each of the three course areas, and complete an interdisciplinary senior project. The NEXA major is a concentration in Liberal Studies requiring 42 units of course work. These students must include two Sequences courses, one each of Concepts and Issues, and the required senior project.

The NEXA program enriches faculty knowledge and capabilities in their own and related disciplines. Professors entering the program receive a one course reduction in their teaching assignments in the semester prior to actual participation. During this time they work closely with faculty members in other disciplines to develop courses for the following semester. Not only do the individual professors gain insights into the methodology and approaches used in different areas of study, but they also become better able to view a subject from perspectives other than those from their own training.

Faculty also participate in a staff seminar which meets weekly to produce and review reports on the aims of the program, to evaluate courses both in progress and under development, and to consider the design of the curriculum as a whole.

NEXA public programming began in order to share information about the program with other campuses and the community, but soon became a vehicle for faculty and curricular development as well. The first of these public events, a symposium entitled Sociobiology: Implications for Human Studies, was held in June 1977. As a result, an anthology of the papers presented was published as *Sociobiology and Human Nature* in October 1978. In this instance, a course on Animal-Human Behavior was significantly redesigned as a result of information gained at the symposium.

Evaluation of the program involves faculty self-evaluations, student course ratings, and monitoring of the program by the NEXA steering committee. This year the steering committee will appoint two scientists, two humanists, and one student to review the program and make recommendations for possible changes. This group will examine the internal coherence of the program and analyze how effectively NEXA fits into other campus

curricula, particularly General Studies. NEXA also has an advisory board of representatives from other colleges, large corporations, and hospitals in the community. This board and the steering committee meet once each semester and exchange ideas for the improvement of the program.

The originators of the program have been encouraged by the rapidity with which they have been able to achieve their objectives. The original proposal for the five-year project called for the inclusion of NEXA in the regular curriculum by the end of the grant period. In the spring of 1978, NEXA became part of the academic program with a budget from the provost's office, two years ahead of schedule. Faculty members, regardless of their degree of involvement in the program, respect the balance between imagination and rigor in the curriculum; students are excited about NEXA courses despite high standards (and lower grade points). In addition, NEXA has received other federal and foundation grants, enhanced the reputation of the university, and produced two books.

All this does not suggest, however, that there is no room for improvement. While student enthusiasm has been high, class size has been relatively small. Once NEH funding ends, the program will need to have significantly larger enrollments to justify its staff and budget. Two new courses on science and culture and alternative futures are being designed to draw more students to NEXA.

In addition to overall enrollment, the program is concerned about their choices among NEXA offerings. Examples of the discrepancy between faculty and student operations are the courses on Copernicus and Newton. While the developers of the program have regarded the Sequences courses to be central to the goal of providing a coherent overview, student interest seems to be directly proportional to the timeliness of the subject matter. While the integrity of NEXA as a program demands the continuation of courses in Copernicus and Newton, these courses will probably always represent an enrollment deficit that must be made up by other offerings.

Thus in the years ahead, NEXA will strive to maintain its intellectual and academic standards. At the same time, the faculty must balance intrinsic value with productivity in deliberations on course revision, course deletion, and the development of new or replacement courses. In short, the leaders will have to be both idealistic and practical in taking NEXA into its mature, post-grant stage.

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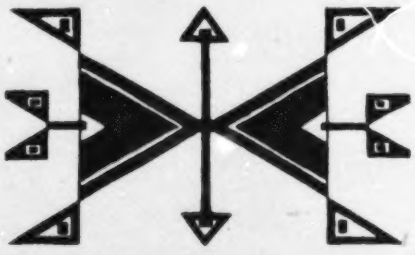

Additional Programs

The following institutions have programs which have recently come to the attention of the *Forum*.

Carnegie-Mellon University, Pittsburgh, PA 15213
Program in Technology and Humanities—The program stimulates interest, teaching, and research in the areas of technology-society interactions through interdisciplinary graduate and undergraduate courses, support for graduate research, and support for seminars and visiting lecturers.
Joel A. Tarr, Director

Dickinson College, Carlisle, PA 17013
Science as a Human Enterprise—Freshman-level introductory seminars will explore the changing relationship of science to society, and will consider specific issues of past and present scientific interest in the light of humanistic concerns.
George Allan, Dean of the College, and E. Robert Paul, Project Directors

Douglass College, Rutgers, The State University, New Brunswick, NJ 08903
Science and Society—This pilot interdisciplinary course considers current and future quantities of resources in energy, materials, and food, the problems arising from distribution systems among nations and among peoples within nations, and the social pressures resulting from rising human aspirations.
James Johnson, Chairperson, Religion Department

University of Iowa, Iowa City, IA 52242
Literature, Science, and the Arts—This interdisciplinary program includes the course, Human Nature and the Impact of Science, which emphasizes the relationship of scientific to religious, humanistic, and social thought against a background of major historical developments.
John A.A. ter Harr, Department of German

Oregon State University, Corvallis, OR 97331
An Exploration of Community—This program will link the humanities with strong academic programs in the university's scientific and professional schools. Courses, focusing on the interplay of the humanities in all areas of human affairs, include Northwest Studies, Marine and Maritime Studies, Community as People, Place, and Idea, and Science, Technology, and Community.
Richard Astro, Project Director

Portland State University, Portland, OR 97207
Science and Humanities Project—Ten interdisciplinary courses (which satisfy distribution requirements) have been developed for a two-year program integrating the social and natural sciences with the humanities.
Michael F. Reardon, Project Director

St. Louis University, St. Louis, MO 63103
Man, Technology, and Society Program—An integrated curriculum encourages humanistic perspectives in the assessment of technology. Certificate programs in Technology Studies and Technology and the Future combine a broad multidisciplinary perspective with a strong humanistic component.
Frederick J. Dobney, Program Director

Stevens Institute of Technology, Hoboken, NJ 07030
Department of Humanities—Students are required to take one humanities course per semester in areas such as literary and philosophical analysis, American studies, humanistic studies of science and technology, the historical and social sciences, and the arts.
Edward A. Friedman, Dean of the College

Wesleyan University, Middletown, CT 06457
Science as a Humanistic Discipline—Courses have been designed and implemented within the College of Letters which explore aspects of the interpenetration of humanistic imagination and scientific creativity. Mathematics, demography, and psychoanalysis are included in the program, as well as biology, chemistry, and physics.
Richard T. Vann, Professor of History and Letters

University of Wisconsin-Milwaukee, Milwaukee, WI 53201
Cultural and Technological Studies Program—Over forty humanities and social science courses have been developed which emphasize technological issues. Courses are divided into three phases, the first of which is introductory to general areas of study; phase two courses look more rigorously at the themes developed in phase one; phase three courses focus on social responsibility and the professional as an agent of change.
Raymond H. Merritt, Director

Resources

Donovan, Timothy. "Math and English as Integrated Disciplines." Northeastern University, 1977. (ED 146 598)
The author believes that a synthesis of mathematics and composition can enable one to present ideas more clearly and forcefully. Methods to integrate these two areas are suggested, with an emphasis on the role of mathematics in this process.

EVIST Resource Directory. Washington: American Association for the Advancement of Science, 1978.
This directory of programs and specific courses in the field of ethics and values in science and technology includes offerings at over 500 institutions across the country. Names of program directors and related program data are included for referral.

Gosselin, Edward A., and Lawrence S. Lerner. "History of Science as a Device for Reconciling the Science and the Humanities." *Teaching History: A Journal of Methods*, vol. 2, no. 2, Fall 1977, pp. 41-49. Available from the Division of Social Sciences, Emporia State University, Emporia, Kansas. (EJ 170 584)
This essay presents the rationale and methodology utilized in order to prepare two integrative science/humanities courses.

Higginson, William, ed. *An Image of the Whole: Knowledge and Curriculum in an Age of Fragmentation*. Proceedings of a series of symposia cosponsored by the Canadian Centre for Integrative Education and the Faculty of Education, Queen's University, Kingston, Ontario, Canada, 1978. (ED 153 817)
This series of symposia dealt with the issue of overspecialization in contemporary education and the need for ways in which to balance this trend. The essays included here view the problem in the fields of mathematics, science, philosophy, social sciences, art, and integrative education.

Hungerford, Harold R., et al. "Goals for Curriculum Development in Environmental Education." 13 pp. 1978. (ED 156 536)
The goals listed in this paper are in response to objectives proposed at the Tbilisi Intergovernmental Conference on Environmental Education in 1977. The goals are grouped at four levels: ecological foundations, conceptual awareness, investigation and evaluation, and environmental action skills.

Mastichelli, Judith, and Christine Roysdon. *Beyond Technics: Humanistic Interaction with Technology*. Humanities Perspectives on Technology Program, Lehigh University. Bethlehem: Lehigh University Libraries, 1978.
This annotated bibliography presents a concise overview of literature concerned with technology's effect on civilization. The works cited consider technology from a humanistic point of view, organized under such headings as anthologies, art, literature, fiction and poetry, philosophy and ethics, and case studies. In addition, a guide to journals relevant to the STS field is included.

MPC and NEH Humanities Conference at Santa Cruz. Conference Report. Monterey Peninsula College, 1976. (ED 152 348)
In describing interdisciplinary humanities programs at two- and four-year institutions, this report includes three essays particularly appropriate to the subject of science/humanities integration: "Technology and the Humanities," by Neil Harris; "Politics, Science, and the English Language," by Michael S. Gregory; and "Humanities for Technology Students," by Gary Roberts and James Stewart.

Sanzone, George. "Undergraduate Research in Chemistry: A Liberal Arts Subject." *Journal of Chemical Education*, vol. 54, no. 9, 1977, pp. 556-558. (EJ 179 826)
This brief article describes a liberal arts program designed to teach chemistry to non-chemistry majors.

Snow, C.P. *The Two Cultures and the Scientific Revolution*. New York: Cambridge University Press, 1959.
The author writes of the end of a common culture among educated persons. With the lack of communication between the scientist and the humanist, we are more likely to "interpret the past wrongly, to misjudge the present, and to deny our hopes for the future."

White, Alvin H. "Humanistic Mathematics: An Experiment." *Education*, vol. 95, no. 2, pp. 128-133.
Dr. White's essay reports on an experimental calculus seminar which tested the effectiveness of an informal, student-centered approach to what is traditionally a very structured subject. Special attention was given in the course to students' gaining confidence in their ability to approach the material independently. In addition to details about the format of the course, Dr. White includes reactions from the students who participated in it.

The *Forum for Liberal Education* examines curricular programs and other academic activities at two- and four-year colleges, universities, and graduate and professional schools. The *Forum* invites your contribution of information on the following topics, which will be featured in upcoming issues: faculty development, honors programs, religious studies, creative arts, program evaluation, ethics and business, teaching values, and new ways of teaching the natural sciences.

The *Forum* will expand to eight issues for the 1979-1980 academic year. Subscription prices will remain at $12 for persons at AAC member institutions and $18 for all others. Reduced rates for group orders at a single institution or for multiple copies of back issues are available upon request. Please address all correspondence to:

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